

## CLAIMS

1. A method of performing a reduction operation in a cryptographic calculation, the method comprising selecting a modulus having a first section with a plurality of "1" Most Significant Word states and a second section which  
5 comprises a plurality of "1" or "0" states whereby the number formed of the two sections is a modulus or a multiple of a modulus, and operating (S1-S5; S10-S12; S20-S26) a reduction operation on the modulus/multiple.
2. A method according to Claim 1 comprising effecting a plurality of  
10 multiplication operations (S1).
3. A method according to Claim 2 comprising effecting a plurality of multiplication operations followed by effecting a reduction operation (S1, S2).
- 15 4. A method according to Claim 3 comprising repeating the combined multiplication operations and reduction operation (S1, S2).
5. A method according to any preceding claim comprising using a multiple of the modulus/multiple.  
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6. A method according to any preceding claim wherein, when the last multiplication gives an overflow (S4), the overflow is added to a part of the selected number.
- 25 7. A method according to Claim 6 wherein, when the overflow addition step (S4) produces an overflow, then  $n_0'$  (S5) is added to the overflow.
8. A method according to any preceding claim, wherein the carry  $c$  between two adjacent multiplications is effected as the addend in the next  
30 multiplication (S2).

9. A method according to any preceding claim comprising monitoring the number of leading "1"s to determine if the number is less than (k-2).

5 10. A method according to Claim 6 comprising initiating the next calculation when the number of leading "1"s is less than (k-2).

10 11. A method according to any preceding claim the method comprising operating 192-bit ECC and a word size of 64-bit, the modulus comprises a first section of 138 bits and a second section of 54 bits.

12. A method according to any of Claims 1 to 10 the method comprises operating 128-bit ECC and a word size of 64-bit, the modulus comprises a first section of 74 bits and a second section of 54 bits.

15 13. A method according to any of Claims 1 to 10 the method comprising operating 256-bit ECC and a word size of 64-bit, the modulus comprises a first section of 202 bits and a second section of 54 bits.

20 14. A computer program product directly loadable into the internal memory of a digital computer, comprising software code portions for performing the method of any one or more of Claims 1 to 13 when said product is run on a computer.

25 15. A computer program directly loadable into the internal memory of a digital computer, comprising software code portions for performing the method of any one or more of Claims 1 to 13 when said program is run on a computer.

30 16. A carrier, which may comprise electronic signals, for a computer program of Claim 15.

17. Electronic distribution of a computer program product of Claim 14 or a computer program of Claim 15 or a carrier of Claim 16.

18. Apparatus for performing a reduction operation in a cryptographic calculation, the apparatus comprising means to select a modulus or a multiple of a modulus having a first section with a plurality of "1" states and a second section having a plurality of "1" or "0" states whereby the number formed of the two sections is a modulus or a multiple of a modulus, and means (10-17) for operating a reduction operation on the modulus/multiple.

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19. Apparatus according to Claim 18 comprising means (10-17) to effect a plurality of multiplication operations.

20. Apparatus according to Claim 19 comprising means (10-17) to effect a plurality of multiplication operations followed by a reduction operation.

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21. Apparatus according to Claim 20 comprising means (10-17) to repeat the combined multiplication operations and reduction operation.

22. Apparatus according to any of Claims 18 to 21 comprising means (10-17) to use a multiple of the modulus/multiple.

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23. Apparatus according to any of Claims 18 to 22 comprising means (10-17), when the last multiplication gives an overflow, to add the overflow to a part of the selected number.

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24. Apparatus according to Claim 23 comprising means (10-17), when the overflow addition step produces an overflow, to add  $n_0'$  to the overflow.

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25. Apparatus according to any of Claims 18 to 24 (10-17) comprising means to effect the carry  $c$  between two adjacent multiplications as the addend in the next multiplication.

5 26. Apparatus according to any of Claims 18 to 25 (10-17) comprising means to monitor the number of leading "1"s to determine if the number is less than  $(k-2)$ .

10 27. Apparatus according to any of Claims 18 to 26 comprising means (10-17) to initiate the next calculation when the number of leading "1"s is less than  $(K-2)$ .

15 28. Apparatus according to any of Claims 18 to 27 with means (10-17) for 192-bit EEC and a word size of 64-bit, the modulus comprises a first section of 74 bits and a second section of 54 bits.

20 29. Apparatus according to any of Claims 18 to 27 with means (10-17) for 128-bit ECC and a word size of 64-bit, the modulus comprises a first section of 74 bits and a second section of 54 bits.

30 30. Apparatus according to any of Claims 18 to 27 with means (10-17) for 256-bit ECC and a word size of 64-bit, the modulus comprises a first section of 202 bits and a second section of 54 bits.

25 31. A method of performing a reduction operation substantially as hereinbefore described with reference to, and/or as illustrated in, any one or more of Figures 1 to 5 of the accompanying drawings.

30 32. Apparatus for performing a reduction operation in a cryptographic calculation, the apparatus substantially as hereinbefore described with reference to, and/or as illustrated in, any one or more of Figures 1 to 5 of the accompanying drawings.

33. A method of performing a reduction operation in a cryptographic calculation, the method substantially as hereinbefore described with reference to, and/or as illustrated in, any one or more of Figures 1 to 5 of the  
5 accompanying drawings.